

**Ameren Labadie Sulfur Reduction Project Air Quality and
Meteorological Monitoring Network**

2015 SO₂ and Meteorological Audit Data

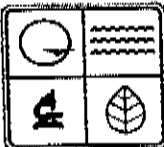
Submitted To:

Ameren Services
1901 Chouteau Avenue
St. Louis, MO 63166-6149

Submitted By:

Enviroplan Consulting
155 Route 46 West
Wayne Plaza II, Suite 109
Wayne, NJ 07470

ANNUAL PERFORMANCE EVALUATION - SULFUR DIOXIDE

SITE NAME:	Northwest		AUDITOR:	D. Malorin
AQS-APCP ID:	071-0003		AUDIT DATE:	4/22/2015
Parameter:	SO2 - 42401		SITE OPERATOR:	K. Ruggiero
Monitor Type:	Method 100		ORGANIZATION:	Enviroplan

INSTRUMENT

ANALYZER MODEL: Teledyne-API model T100
Ultraviolet Fluorescence
SERIAL NUMBER: 534

REFERENCE STANDARDS

Gas Dilution System: Environics 4757
Pollutant Gas: Airgas FF55927
Zero Air: Purakol/Purafil

EPA AUDIT LEVEL:	Zero	5	6	7	8
REFERENCE (PPB):	0.0	28.3	67.9	118.3	188.0
MONITOR RESPONSE:	-0.2	28.7	69.8	120.8	192.8
PPB Difference	-0.2	0.4	1.9	2.5	4.8
Δ% Difference	na	1.4%	2.8%	2.1%	2.6%

Zero MQO +/-1.5 PPB

Audit Δ% MQO +/- 10 %

LINEARITY EVALUATION:

Regression Output:	SLOPE	0.97	CORRELATION CF	1.0000
	INTERCEPT	0.2		

EPA Audit Level:	Zero	5	6	7	8
Dilution air flow sccm:	6000	7000	7000	5000	5000
Pollutant gas flow sccm:	0	17	40	50	80

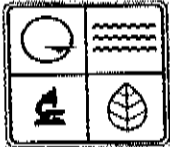
Calibration range PPB:	500
Cal. cylinder expire:	OCT 2022
dilution system cert:	OK

Sample inlet manifold condition:	OK
Calibration Date:	4/20/2015
QC Date:	4/21/2015

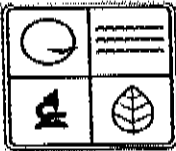
Instrument within design specifications?	YES	VSR Issued?	NO
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COMMENTS:

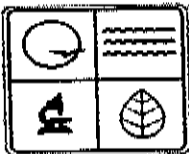
ANNUAL PERFORMANCE EVALUATION - SULFUR DIOXIDE

SITE NAME: Ameren Valley AQS-APCP ID: 071-0003 Parameter: SO2 - 42401 Monitor Type: Method 100				AUDITOR: D. Malorin AUDIT DATE: 4/21/2015 SITE OPERATOR: K. Ruggiero ORGANIZATION: Enviroplan									
INSTRUMENT ANALYZER MODEL: Teledyne-API model T100 Ultraviolet Fluorescence SERIAL NUMBER: 543			REFERENCE STANDARDS Gas Dilution System: Environics 4757 Pollutant Gas: Airgas FF55927 Zero Air: Purakol/Purafil										
EPA AUDIT LEVEL:	Zero	5	6	7	8								
REFERENCE (PPB):	0.0	28.3	67.9	118.3	188.0								
MONITOR RESPONSE:	0.4	30.2	72.5	126.3	200.1								
PPB Difference	0.4	1.9	4.6	8.0	12.1								
Δ% Difference	na	6.7%	6.8%	6.8%	6.4%								
Zero MQO +/-1.5 PPB Audit Δ% MQO +/- 10 %													
LINEARITY EVALUATION: Regression Output: <table border="1" data-bbox="474 1268 1365 1356"> <tr> <td>SLOPE</td> <td>0.94</td> <td>CORRELATION CF</td> <td>1.0000</td> </tr> <tr> <td>INTERCEPT</td> <td>-0.3</td> <td></td> <td></td> </tr> </table>						SLOPE	0.94	CORRELATION CF	1.0000	INTERCEPT	-0.3		
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INTERCEPT	-0.3												
EPA Audit Level:	Zero	5	6	7	8								
Dilution air flow sccm:	6000	7000	7000	5000	5000								
Pollutant gas flow sccm:	0	17	40	50	80								
Calibration range PPB:	500	Sample inlet manifold condition:		OK									
Cal. cylinder expire:	OCT 2022	Calibration Date:		4/18/2015									
dilution system cert:	OK	QC Date:		4/21/2015									
Instrument within design specifications?	YES	VSR Issued?	NO										
COMMENTS:													

PERFORMANCE EVALUATION - Anemometer - Wind Speed - Wind Direction

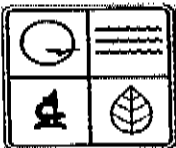
SITE NAME: Ameren Valley Installation ID: 071-0003 Parameter: WS-WD Monitor Type: 10m Dispersion				AUDITOR: D. Malorin AUDIT DATE: 4/21/2015 SITE OPERATOR: D. Cummings ORGANIZATION: Enviroplan																					
INSTRUMENT ANEMOMETER MODEL: Climatronics F-460 system WD - Vane - model 100076 WS (horizontal) - cups - model 100075 WS (vertical) - propeller - model 102236 SERIAL NUMBER: N2310C / P12197 / N2289C				REFERENCE STANDARDS Vane Angle Bench: crossarm visual alignment Cup/Prop Speed: RMY 18802 synchronous motor																					
WIND DIRECTION SENSOR EVALUATION																									
Vane Sensor Linearity MQO is +/- 3.0 degrees.		<table border="1"> <thead> <tr> <th>Direction</th> <th>Reference</th> <th>DL Response</th> </tr> </thead> <tbody> <tr> <td>North</td> <td>0.0</td> <td>1.2</td> </tr> <tr> <td>East</td> <td>90.0</td> <td>92.6</td> </tr> <tr> <td>South</td> <td>180.0</td> <td>182.7</td> </tr> <tr> <td>West</td> <td>270.0</td> <td>271.4</td> </tr> </tbody> </table>	Direction	Reference	DL Response	North	0.0	1.2	East	90.0	92.6	South	180.0	182.7	West	270.0	271.4								
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North	0.0	1.2																							
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West	270.0	271.4																							
WIND SPEED SENSOR EVALUATION																									
Horizontal Sensor Calibration Verification MQO: +/- 0.2 m/s		<table border="1"> <thead> <tr> <th>RPM</th> <th>Reference (m/s)</th> <th>DL Response</th> </tr> </thead> <tbody> <tr> <td>200</td> <td>4.84</td> <td>4.8</td> </tr> <tr> <td>300</td> <td>7.19</td> <td>7.3</td> </tr> <tr> <td>600</td> <td>14.25</td> <td>14.4</td> </tr> <tr> <td>900</td> <td>21.31</td> <td>21.3</td> </tr> </tbody> </table>	RPM	Reference (m/s)	DL Response	200	4.84	4.8	300	7.19	7.3	600	14.25	14.4	900	21.31	21.3								
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Vertical Sensor Calibration Verification MQO: +/- 0.2 m/s		<table border="1"> <thead> <tr> <th>RPM</th> <th>Reference (m/s)</th> <th>CW DL Response</th> <th>CCW DL Resp</th> </tr> </thead> <tbody> <tr> <td>200</td> <td>1.25</td> <td>na</td> <td>na</td> </tr> <tr> <td>300</td> <td>1.88</td> <td>1.92</td> <td>-1.86</td> </tr> <tr> <td>600</td> <td>3.75</td> <td>3.78</td> <td>-3.72</td> </tr> <tr> <td>900</td> <td>5.63</td> <td>5.67</td> <td>-5.60</td> </tr> </tbody> </table>	RPM	Reference (m/s)	CW DL Response	CCW DL Resp	200	1.25	na	na	300	1.88	1.92	-1.86	600	3.75	3.78	-3.72	900	5.63	5.67	-5.60			
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200	1.25	na	na																						
300	1.88	1.92	-1.86																						
600	3.75	3.78	-3.72																						
900	5.63	5.67	-5.60																						
WIND DIRECTION TOTAL SYSTEM ERROR EVALUATION:																									
Instrument error: 1.2		*From vane alignment audit																							
Total System error: -1.1 degrees		Orientation error: -2.3																							
MQO is +/- 5.0 degrees total system error.																									
MQO SOURCE: QA Handbook Volume IV (2008) / MMGRMA "EPA-454/R-99-005" (FEB 2000)																									
Instrument within design specifications?		YES		VSR Issued?																					
				NO																					
COMMENTS:																									

PERFORMANCE EVALUATION - Anemometer Orientation

SITE NAME: Ameren Valley APCP Installation ID: 071-0003 Parameter: WD Monitor Type: 10m Dispersion				AUDITOR: D. Malorin AUDIT DATE: 4/21/2015 SITE OPERATOR: D. Cummings ORGANIZATION: Enviroplan	
<u>INSTRUMENT</u> ANEMOMETER MODEL: Climatronics model F-460 vane SERIAL NUMBER: N2310C (vane only)			<u>REFERENCE STANDARD METHOD</u> Compass Model: Suunto KB-14/360R G Serial Number: 14142737		
AQS LATITUDE: 40.0272 AQS LONGITUDE: 95.2358 NOAA DECLINATION: 0.84		N W W		(Units are Decimal Degrees) SOURCE: WWW.NGDC.NOAA.GOV	
METHOD: Anemometer orientation is determined with a magnetic compass on a tripod. An orientation rod is mounted on the tower. The compass is then aligned with the rod. The magnetic site variation for this method and site is determined by NOAA-NGDC for the given date. If NOAA declination is 20 E, the magnetic compass needle will point 20 to the East of true map North. To calculate the expected MAP (True) North compass value, subtract 20 from 360. For a West declination, add the deviation to 360, to get the expected map north value at the site.					
Expected compass reading indicating MAP (true) North:				360.8	
ORIENTATION EVALUATION:					
Site compass reading:		358.5		degrees	
Orientation error:		-2.3		degrees	
Total System error:		-1.1		MQO Limit is +/- 5.0 degrees total system error.	
*From Instrument WD audit Instrument error: 1.2					
SOURCE: QA Handbook Volume IV (2008) and MMGRMA EPA-454/R-99-005 (FEB 2000)					
Instrument within design specifications?		YES		VSR Issued? NO	
Adjustment needed?		NO		Post-adjustment compass reading: NA	
COMMENTS: Declination uncertainty is +/- 0.36 degrees. QC error was -1.0 degrees.					

W E J

PERFORMANCE EVALUATION - Ambient Temperature and Temperature Difference

SITE NAME:	Ameren Valley		AUDITOR:	D. Malorin
Installation ID:	071-0003		AUDIT DATE:	4/21/2015
Parameter:	Ambient Temperature		SITE OPERATOR:	D. Cummings
Monitor Type:	Dispersion Modeling		ORGANIZATION:	Enviroplan

TEMPERATURE REFERENCE STANDARD
 Model: Fisher Scientific Traceable Digital (immersed in water bath)
 Serial Number: 230040377 and 61457725

2-Meter Station Temperature Sensor
 Serial Number: P11360
 Model / Type: Climatronics model 100093 mounted in a TS-10 motor-aspirated shield
 (the model 100093 is a dual-element thermistor encased in a stainless steel sheath)

10-Meter Station Temperature Sensor
 Serial Number: P10913
 Model / Type: Climatronics model 100093 mounted in a TS-10 motor-aspirated shield
 (the model 100093 is a dual-element thermistor encased in a stainless steel sheath)

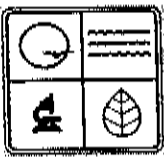
Low Temperature (0 °C)	2-Meter Probe:	0.3	ΔT MQO: +/- 0.1 °C MQO: +/- 0.5 °C
	10-Meter Probe:	0.3	
	Reference Standard:	0.2	
"Ambient" Temperature (20 °C)	2-Meter Probe:	23.3	ΔT MQO: +/- 0.1 °C MQO: +/- 0.5 °C
	10-Meter Probe:	23.4	
	Reference Standard:	23.3	
High Temperature (40 °C)	2-Meter Probe:	38.8	ΔT MQO: +/- 0.1 °C MQO: +/- 0.5 °C
	10-Meter Probe:	38.8	
	Reference Standard:	38.5	

MQO source: EPA QA Handbook Volume IV (2008) and MMGRMA "EPA-454/R-99-005" (FEB 2000)

Instruments within design specifications?	YES	VSR Issued?	NO
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COMMENTS: Aspirator motor current draw is monitored by the datalogger.

PERFORMANCE EVALUATION - PRECIPITATION

SITE NAME:	Ameren Valley		AUDITOR:	D. Malorin
Installation ID:	071-0003		AUDIT DATE:	4/21/2015
Parameter:	Precipitation		SITE OPERATOR:	D. Cummings
Monitor Type:	Dispersion Modeling		ORGANIZATION:	Enviroplan

INSTRUMENT

MODEL: Climatronics model 100097
Heated Tipping Bucket Rain Gauge (8-inch collector)
SERIAL NUMBER: N15508

REFERENCE STANDARDS

Fluid Volume: 100 mL glass buret
Pyrex - Class B - graduated 0.2 mL
*Verified with Mettler Balance

PRECIPITATION MEASUREMENT AUDIT

Inlet Diameter (mm):	203.2	= 8.0 inches	Ambient Temperature
$A = \pi r^2$	32429	mm ²	20.0 °C
Tipping Bucket Volume (milli-Liters per tip)	8.2		Ambient Pressure
Resolution (inches of rainfall per tip)	0.01	x counts = in / hr	744 mmHg
Resolution (mm of rainfall per tip)	0.254		

INPUT

Reference Input Volume (mL):
Calculated rainfall input (inches):
Calculated rainfall input (mm):

TEST 1	TEST 2	TEST 3
101.0	99.0	99.5
0.123	0.120	0.121
3.11	3.05	3.07

Instrument Response

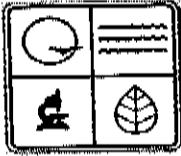
Reported channel value (inches per hour):
Audit Difference in units (inches per hour):
Audit Δ% Difference (of input volume):

0.12	0.12	0.12
-0.003	0.000	-0.001
-0.1%	0.0%	0.0%

MQO Δ%: +/- 10% Source: EPA QA Handbook Vol. IV (2008) and MMGRMA "EPA-454/R-99-005" (2000)

CONDITION OF RAIN GAUGE (Catchment basin and internal component area):			Clean
Is the instrument inlet funnel rim level? Is the tipping bucket mechanism level?			YES
Instrument within design specifications?	YES	VSR Issued?	NO
COMMENTS: Audited at datalogger time 1300 to 1400.			

PERFORMANCE EVALUATION - Relative Humidity

SITE NAME:	Ameren Valley		AUDITOR:	D. Malorin
Installation ID:	071-0003		AUDIT DATE:	4/21/2015
Parameter:	Relative Humidity		SITE OPERATOR:	D. Cummings
Monitor Type:	Dispersion Modeling		ORGANIZATION:	Enviroplan

RELATIVE HUMIDITY REFERENCE STANDARD

Serial Number: 60975030 / 61031996
Model: Rotronic Hygro HP22-A / HC2-S (in multi-plate radiation shield)
(Humidity and Temperature Indicator-Probe)

Station Relative Humidity Sensor

Serial Number: P10993
Model / Type: Climatronics model 102273
(sensor is mounted at 2 meters inside naturally-aspirated solar radiation shield)

Relative Humidity Evaluation

Reference Standard (% RH):

26.7

Reference Temp:

21.0 °C

Station Sensor (% RH):

29.3

Difference (% RH):

2.6

MQO for station relative humidity versus reference standard is +/- 7 % RH.

MQO source: EPA QA Handbook Volume IV (2008) and MMGRMA "EPA-454/R-99-005" (FEB 2000)

Instruments within design specifications?

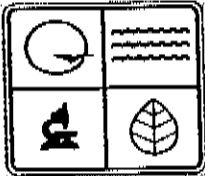
YES

VSR Issued?

NO

COMMENTS:

PERFORMANCE EVALUATION - Barometric Pressure

SITE NAME:	Ameren Valley		AUDITOR:	D. Malorin
Installation ID:	071-0003		AUDIT DATE:	4/21/2015
Parameter:	Barometric Pressure		SITE OPERATOR:	D. Cummings
Monitor Type:	Dispersion Modeling		ORGANIZATION:	Enviroplan

BAROMETRIC PRESSURE REFERENCE STANDARD

Serial Number: 74001263
Model: Druck DPI 740 - Digital Pressure Indicator
(Referenced to a Princo Fortin 453 NWS-type Mercury barometer)

Station Barometric Pressure Sensor

Serial Number: N15783
Model / Type: Climatronics model 102663
(sensor is mounted at 2 meters on tower inside weather-proof sensor enclosure)

Reference Standard (mmHg):

745.0

993.3

millibars

Station Sensor (mmHg):

739.6

986.0

millibars

Difference (mmHg):

-5.4

MQO for Station barometric pressure versus reference pressure standard is +/- 2.3 mmHg (3 millibars).

MQO source: EPA QA Handbook Volume IV (2008) and MMGRMA "EPA-454/R-99-005" (FEB 2000)

Instruments within design specifications?

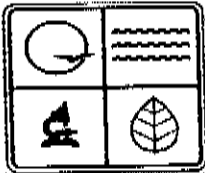
NO

VSR Issued?

NO

COMMENTS: Alternate QA device DPI-705 read 994.2 millibars. QC device read 992 mb.
Instrument ground problem was located and fixed. Instrument was re-evaluated.

PERFORMANCE EVALUATION - Barometric Pressure

SITE NAME:	Ameren Valley		AUDITOR:	D. Malorin
Installation ID:	071-0003		AUDIT DATE:	4/21/2015
Parameter:	Barometric Pressure		SITE OPERATOR:	D. Cummings
Monitor Type:	Dispersion Modeling		ORGANIZATION:	Enviroplan

BAROMETRIC PRESSURE REFERENCE STANDARD

Serial Number: 74001263
Model: Druck DPI 740 - Digital Pressure Indicator
(Referenced to a Princo Fortin 453 NWS-type Mercury barometer)

Station Barometric Pressure Sensor

Serial Number: N15783
Model / Type: Climatronics model 102663
(sensor is mounted at 2 meters on tower inside weather-proof sensor enclosure)

Reference Standard (mmHg):

743.8

991.7

millibars

Station Sensor (mmHg):

744.1

992.0

millibars

Difference (mmHg):

0.3

MQO for Station barometric pressure versus reference pressure standard is +/- 2.3 mmHg (3 millibars).

MQO source: EPA QA Handbook Volume IV (2008) and MMGRMA "EPA-454/R-99-005" (FEB 2000)

Instruments within design specifications?

YES

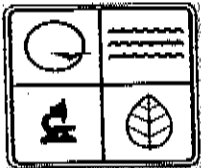
VSR Issued?

NO

COMMENTS:

Alternate QA device DPI-705 read 992.9 millibars. QC device read 992.1 mb.

PERFORMANCE EVALUATION - SOLAR RADIATION

SITE NAME: Ameren Valley		AUDITOR: D. Malorin
Installation ID: 071-0003		AUDIT DATE: 4/21/2015
Parameter: Solar Radiation		SITE OPERATOR: D. Cummings
Monitor Type: Dispersion Modeling		ORGANIZATION: Enviroplan

SOLAR RADIATION REFERENCE STANDARD

Serial Number: LM2-4412 / PY86242

Model: LI-COR LI-250A / LI-200SA (Portable Indicator and Sensor)

*Referenced in AUG 2013 to Eppley Precision Spectral Pyranometer by manufacturer.

Calibration Factor: -10.43 (Watts / m²) per micro-amp

STATION SOLAR RADIATION SENSOR

Serial Number: 37412

Model / Type: Eppley 8-48 Pyranometer

The model 8-48 meets most of the ISO 9060 First Class Specifications but is officially designated as a Second Class Pyranometer for Global Solar Radiation measurements.

Calibration Factor: Transfer function is 8.57×10^{-6} Volts per Watts / m² or $\mu\text{V}/(\text{W}/\text{m}^2)$

(sensor is mounted at approximately 2 meters, on a separate post, east of 10m tower)

Reference Standard (Watts / meter squared):	834
Station Sensor (Watts / meter squared):	824
Difference (W/m ²):	-10.0
	-1.2%

MQO for station Solar Radiation versus reference standard is +/- 5 % Δ.

MQO source: EPA QA Handbook Volume IV (2008) and MMGRMA "EPA-454/R-99-005" (FEB 2000)

Instruments within design specifications?	YES	VSR Issued?	NO
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COMMENTS: Measurements taken at midday during periods of unobstructed daylight.

AIR QUALITY SYSTEMS AUDIT CHECKLIST

(Page 1 of 2)

Network: <i>Ameren Labadie</i>			Audit Date: <i>9-2-15</i>	
Site: <i>Northwest</i>			Auditor: <i>Kevin Ruggiero</i>	
Parameter Monitored	Monitor Model	Monitor Serial No.	Measurement Range	Most Recent Calibration Date
<i>SO₂</i>	<i>TAP1 T100</i>	<i>534</i>	<i>0-500 PPB</i>	<i>5-1-15</i>
OPERATIONS (CONTINUOUS ANALYZERS)			YES	NO
Are all monitors operational?			✓	
Are all analyzer and calibrator fans operational and clean?			✓	
Are all flow rates for analyzers normal?			✓	
Is automatic zero/span operational?			✓	
Is calibration of all monitors current?			✓	
Are analyzer particulate filters changed bi-weekly?			✓	
Is sampling cane and manifold clean and intact?			✓	
Is the manifold blower motor working?			✓	
Are all sample lines clean and moisture-free?			✓	
Is DAS operational and indicating proper time and date?			✓	
Are site visits performed at (minimum) bi-weekly intervals?			✓	
Are P/Z/S checks performed at (minimum) bi-weekly intervals?			✓	
Are manual "Through-the-Probe" P/Z/S checks performed at monthly intervals?			✓	
Are multi-point calibrations performed at (minimum) semi-annual intervals?			✓	
GENERAL SITE CONDITIONS			YES	NO
Is the station interior neat and orderly?			✓	
Is the condition of trailer exterior acceptable?			✓	
Is the site temperature maintained between 20° and 30°C?			✓	
Are the site grounds well maintained?			✓	
DOCUMENTATION AND FORMS			YES	NO
Is the station logbook present?			✓	
Are the station logs up-to-date?			✓	
Are the station logs detailed and legible?			✓	
Are the calibration forms present?			✓	
Are calibration certificates for gas cylinders and calibrators posted?			✓	

AIR QUALITY SYSTEMS AUDIT CHECKLIST

(Page 2 of 2)

Network: Ameren LaSalle	Audit Date: 9-2-15
Site: Northwest	Auditor: Kevin Ruggiero

OVERALL COMMENTS	YES	NO
Overall, is the station well maintained?	✓	
Overall, is the data quality good?	✓	
Are Quality Assurance/Quality Control maintained?	✓	
Is the site and equipment in good working order?	✓	
Do site operating personnel follow safe work practices?	✓	
Are there any safety issues at the monitoring station?	✓	✓ (No)
Overall, is the site technician knowledgeable and following Standard Operating Procedures?	✓	
Are there any unresolved problems at the site? (describe in "Comments" below)		✓

Comments:

Site Technician: _____

Auditor: Ken Kiger

QA Review: Heintz

ENVIROPLAN CONSULTING

CONTINUOUS GASEOUS POLLUTANT ANALYZER AUDIT FORM

PARAMETER AUDITED (Check One): ☒ SO₂ ☐ CO ☐ TRS

Network: <u>Amenon Labadie</u>	Site: <u>Northwest</u>	Audit Date: <u>9-2-15</u>
Time Off-Line: <u>13:06 CST</u>	Time On-Line: <u>14:26 CST</u>	Shelter Temperature: <u>25.7°C</u>

Site Equipment	Analyzer Mfg./Model No.: <u>TAPI T100</u> S/N: <u>534</u> Cal. Date: <u>5-1-15</u>	
	Analyzer Calibration Factors: Span Setting: _____ Zero Setting: _____	
	Calibrator Mfg./Model No.: <u>TAPI T700</u> S/N: <u>548</u> Cal. Date: <u>9-2-15</u>	
	Gas Cylinder Vendor and S/N: <u>Scott Marnin CC12207</u> Tank Pressure: <u>1500</u> PSIG	
	Gas Cylinder Cert. Date: <u>10-14-14</u> Cylinder Conc. (ppm): <u>54.3</u>	
Audit System	Calibrator Mfg./Model No.: <u>TAPI T700</u> S/N: <u>112</u> Cal. Date: <u>6-3-15</u>	
	Zero Air Supply Mfg./Model No.: <u>TAPI M701</u> S/N: <u>4463</u>	
	Gas Cylinder Vendor and S/N: <u>Scott Marnin JA01285</u> Tank Pressure: <u>2000</u> PSIG	
	Gas Cylinder Cert. Date: <u>10-14-14</u> Cylinder Conc. (ppm): <u>53.5</u>	

Calibrator Gas Flow		Calibrator Dilution Flow		Known Audit Concentration (ppb)	System Response		Results Δ%
Calibrator Setting	SCCM	Calibrator Setting	SCCM		Analyzer Output (Volts)	DAS (ppb)	
<u>0.0133</u>	<u>0.0134</u>	<u>4.987</u>	<u>5.134</u>	<u>140</u>	<u>-</u>	<u>132</u>	<u>-5.7</u>
<u>0.0075</u>	<u>0.0077</u>	<u>4.992</u>	<u>5.144</u>	<u>80</u>	<u>-</u>	<u>76</u>	<u>-5.0</u>
<u>0.0028</u>	<u>0.0029</u>	<u>4.997</u>	<u>5.157</u>	<u>30</u>	<u>-</u>	<u>28</u>	<u>-6.7</u>
<u>OFF</u>	<u>OFF</u>	<u>5.000</u>	<u>5.161</u>	<u>0</u>	<u>-</u>	<u>1</u>	<u>-</u>
Slope = <u>0.939024</u> Intercept = <u>0.560976</u> Correlation Coefficient (r) = <u>0.999958</u>							

Comments:

Site Technician: _____

Auditor: Ken Rysio

QA Review: Blair

ENVIROPLAN CONSULTING

AIR QUALITY SYSTEMS AUDIT CHECKLIST

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Network: <i>Amenon Labadie</i>			Audit Date: <i>9-2-15</i>	
Site: <i>Valley</i>			Auditor: <i>Kevin Ruggiero</i>	
Parameter Monitored	Monitor Model	Monitor Serial No.	Measurement Range	Most Recent Calibration Date
<i>SO₂</i>	<i>TAP1 T100</i>	<i>543</i>	<i>0-500 PPB</i>	<i>7-2-15</i>

OPERATIONS (CONTINUOUS ANALYZERS)	YES	NO
Are all monitors operational?	<input checked="" type="checkbox"/>	
Are all analyzer and calibrator fans operational and clean?	<input checked="" type="checkbox"/>	
Are all flow rates for analyzers normal?	<input checked="" type="checkbox"/>	
Is automatic zero/span operational?	<input checked="" type="checkbox"/>	
Is calibration of all monitors current?	<input checked="" type="checkbox"/>	
Are analyzer particulate filters changed bi-weekly?	<input checked="" type="checkbox"/>	
Is sampling cane and manifold clean and intact?	<input checked="" type="checkbox"/>	
Is the manifold blower motor working?	<input checked="" type="checkbox"/>	
Are all sample lines clean and moisture-free?	<input checked="" type="checkbox"/>	
Is DAS operational and indicating proper time and date?	<input checked="" type="checkbox"/>	
Are site visits performed at (minimum) bi-weekly intervals?	<input checked="" type="checkbox"/>	
Are P/Z/S checks performed at (minimum) bi-weekly intervals?	<input checked="" type="checkbox"/>	
Are manual "Through-the-Probe" P/Z/S checks performed at monthly intervals?	<input checked="" type="checkbox"/>	
Are multi-point calibrations performed at (minimum) semi-annual intervals?	<input checked="" type="checkbox"/>	
GENERAL SITE CONDITIONS	YES	NO
Is the station interior neat and orderly?	<input checked="" type="checkbox"/>	
Is the condition of trailer exterior acceptable?	<input checked="" type="checkbox"/>	
Is the site temperature maintained between 20° and 30°C?	<input checked="" type="checkbox"/>	
Are the site grounds well maintained?	<input checked="" type="checkbox"/>	
DOCUMENTATION AND FORMS	YES	NO
Is the station logbook present?	<input checked="" type="checkbox"/>	
Are the station logs up-to-date?	<input checked="" type="checkbox"/>	
Are the station logs detailed and legible?	<input checked="" type="checkbox"/>	
Are the calibration forms present?	<input checked="" type="checkbox"/>	
Are calibration certificates for gas cylinders and calibrators posted?	<input checked="" type="checkbox"/>	

AIR QUALITY SYSTEMS AUDIT CHECKLIST

(Page 2 of 2)

Network: <u>Ameren LaBadie</u>	Audit Date: <u>9-2-15</u>
Site: <u>Valley</u>	Auditor: <u>Kevin Ruggiero</u>

OVERALL COMMENTS	YES	NO
Overall, is the station well maintained?	✓	
Overall, is the data quality good?	✓	
Are Quality Assurance/Quality Control maintained?	✓	
Is the site and equipment in good working order?	✓	
Do site operating personnel follow safe work practices?	✓	
Are there any safety issues at the monitoring station?		✓
Overall, is the site technician knowledgeable and following Standard Operating Procedures?	✓	
Are there any unresolved problems at the site? (describe in "Comments" below)		✓

Comments:

Site Technician:

Auditor:

QA Review:

ENVIROPLAN CONSULTING

CONTINUOUS GASEOUS POLLUTANT ANALYZER AUDIT FORM

PARAMETER AUDITED (Check One): ☒ SO₂ ☐ CO ☐ TRS

Network: <u>Ameren Labadie</u>	Site: <u>Valley</u>	Audit Date: <u>9-2-15</u>
Time Off-Line: <u>09:00 CST</u>	Time On-Line: <u>10:43 CST</u>	Shelter Temperature: <u>25.6°C</u>

Site Equipment	Analyzer Mfg./Model No.: <u>TAPI T100</u> S/N: <u>543</u> Cal. Date: <u>7-2-15</u>	
	Analyzer Calibration Factors: Span Setting: <u>0.969</u> Zero Setting: <u>15.6</u>	
	Calibrator Mfg./Model No.: <u>TAPI T700</u> S/N: <u>547</u> Cal. Date: <u>9-2-15</u>	
	Gas Cylinder Vendor and S/N: <u>Scott Marrin CC102857</u> Tank Pressure: <u>1900</u> PSIG	
	Gas Cylinder Cert. Date: <u>10-14-14</u> Cylinder Conc. (ppm): <u>54.1</u>	
Audit System	Calibrator Mfg./Model No.: <u>TAPI T700</u> S/N: <u>112</u> Cal. Date: <u>6-3-15</u>	
	Zero Air Supply Mfg./Model No.: <u>TAPI M701</u> S/N: <u>4462</u>	
	Gas Cylinder Vendor and S/N: <u>Scott Marrin JA01285</u> Tank Pressure: <u>2000</u> PSIG	
	Gas Cylinder Cert. Date: <u>10-14-14</u> Cylinder Conc. (ppm): <u>53.5</u>	

Calibrator Gas Flow		Calibrator Dilution Flow		Known Audit Concentration (ppb)	System Response		Results Δ%
Calibrator Setting	SCCM	Calibrator Setting	SCCM		Analyzer Output (Volts)	DAS (ppb)	
<u>0.0133</u>	<u>0.0134</u>	<u>4.987</u>	<u>5.134</u>	<u>140</u>	<u>-</u>	<u>130</u>	<u>-7.1</u>
<u>0.0078</u>	<u>0.0077</u>	<u>4.992</u>	<u>5.144</u>	<u>80</u>	<u>-</u>	<u>74</u>	<u>-7.5</u>
<u>0.0028</u>	<u>0.0029</u>	<u>4.997</u>	<u>5.157</u>	<u>30</u>	<u>-</u>	<u>27</u>	<u>-10.0</u>
<u>OFF</u>	<u>OFF</u>	<u>5.000</u>	<u>5.161</u>	<u>0.000 (NR)</u>	<u>-</u>	<u>0.00 (NR)</u>	<u>-</u>

Slope = 0.925055 Intercept = 0.184035 Correlation Coefficient (r) = 0.999913
0.994346 -0.771619 0.999909

Comments:

Site Technician: _____ Auditor: Ken Rysio

QA Review: [Signature]

ENVIROPLAN CONSULTING

AIR QUALITY SYSTEMS AUDIT CHECKLIST

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Network: AMEREN LABADIE			Audit Date: 10/8/15	
Site: NORTHWEST			Auditor: KEVIN RUGGIERO	
Parameter Monitored	Monitor Model	Monitor Serial No.	Measurement Range	Most Recent Calibration Date
SO2	TAPI T100	534	0 TO 500 PPB	9/3/15
OPERATIONS (CONTINUOUS ANALYZERS)			YES	NO
Are all monitors operational?			✓	
Are all analyzer and calibrator fans operational and clean?			✓	
Are all flow rates for analyzers normal?			✓	
Is automatic zero/span operational?			✓	
Is calibration of all monitors current?			✓	
Are analyzer particulate filters changed bi-weekly?			✓	
Is sampling cane and manifold clean and intact?			✓	
Is the manifold blower motor working?			✓	
Are all sample lines clean and moisture-free?			✓	
Is DAS operational and indicating proper time and date?			✓	
Are site visits performed at (minimum) bi-weekly intervals?			✓	
Are P/Z/S checks performed at (minimum) bi-weekly intervals?			✓	
Are manual "Through-the-Probe" P/Z/S checks performed at monthly intervals?			✓	
Are multi-point calibrations performed at (minimum) semi-annual intervals?			✓	
GENERAL SITE CONDITIONS			YES	NO
Is the station interior neat and orderly?			✓	
Is the condition of trailer exterior acceptable?			✓	
Is the site temperature maintained between 20° and 30°C?			✓	
Are the site grounds well maintained?			✓	
DOCUMENTATION AND FORMS			YES	NO
Is the station logbook present?			✓	
Are the station logs up-to-date?			✓	
Are the station logs detailed and legible?			✓	
Are the calibration forms present?			✓	
Are calibration certificates for gas cylinders and calibrators posted?			✓	

AIR QUALITY SYSTEMS AUDIT CHECKLIST

(Page 2 of 2)

Network: AMEREN LABADIE	Audit Date: 10/8/15
Site: NORTHWEST	Auditor: KEVIN RUGGIERO

OVERALL COMMENTS	YES	NO
Overall, is the station well maintained?	✓	
Overall, is the data quality good?	✓	
Are Quality Assurance/Quality Control maintained?	✓	
Is the site and equipment in good working order?	✓	
Do site operating personnel follow safe work practices?	✓	
Are there any safety issues at the monitoring station?	✓	
Overall, is the site technician knowledgeable and following Standard Operating Procedures?	✓	
Are there any unresolved problems at the site? (describe in "Comments" below)		✓

Comments:

Site Technician:

Auditor:

QA Review:

ENVIROPLAN CONSULTING

CONTINUOUS GASEOUS POLLUTANT ANALYZER AUDIT FORM

PARAMETER AUDITED (Check One): ☒ X ☐ SO₂ ☐ CO ☐ TRS

Network: AMEREN LABADIE	Site: NORTHWEST	Audit Date: 10/8/15
Time Off-Line: 09:22 CST	Time On-Line: 10:50 CST	Shelter Temperature: 25.5° C

Site Equipment	Analyzer Mfg./Model No.: TAPI T100	S/N: 543	Cal. Date: 9/3/15
	Analyzer Calibration Factors:	Span Setting: 1.037	Zero Setting: 22.0
	Calibrator Mfg./Model No.: TAPI T700	S/N: 548	Cal. Date: 9/2/15
	Gas Cylinder Vendor and S/N: SCOTT MARRIN CC122007	Tank Pressure: 1525 PSIG	
	Gas Cylinder Cert. Date: 10/14/14	Cylinder Conc. (ppm): 54.3	
Audit System	Calibrator Mfg./ Model No.: TAPI T700	S/N: 112	Cal. Date: 6/3/15
	Zero Air Supply Mfg./Model No.: TAPI M701	S/N: 4661	
	Gas Cylinder Vendor and S/N: SCOTT MARRIN JA01285	Tank Pressure: 1925 PSIG	
	Gas Cylinder Cert. Date: 10/14/14	Cylinder Conc. (ppm): 53.5	

Calibrator Gas Flow		Calibrator Dilution Flow		Known Audit Concentration (ppb)	System Response		Results
Calibrator Setting	SCCM	Calibrator Setting	SCCM		Analyzer Output (Volts)	DAS (ppb)	Δ%
0.0135	0.0137	4.987	5.252	140	-	132	-5.7
0.0076	0.0078	4.992	5.262	80	-	75	-6.3
0.0027	0.0030	4.991	5.268	30	-	28	-6.7
OFF	OFF	5.000	5.256	0	-	0	-
Slope = 0.943016				Intercept = -0.188470		Correlation Coefficient (r) = 0.999993	

Comments:

Site Technician: _____

Auditor: Hemphill

QA Review: Hemphill

ENVIROPLAN CONSULTING

AIR QUALITY SYSTEMS AUDIT CHECKLIST

(Page 1 of 2)

Network: AMEREN LABADIE			Audit Date: 10/8/15	
Site: VALLEY			Auditor: KEVIN RUGGIERO	
Parameter Monitored	Monitor Model	Monitor Serial No.	Measurement Range	Most Recent Calibration Date
SO2	TAPI T100	543	0 TO 500 PPB	9/5/15
OPERATIONS (CONTINUOUS ANALYZERS)			YES	NO
Are all monitors operational?			✓	
Are all analyzer and calibrator fans operational and clean?			✓	
Are all flow rates for analyzers normal?			✓	
Is automatic zero/span operational?			✓	
Is calibration of all monitors current?			✓	
Are analyzer particulate filters changed bi-weekly?			✓	
Is sampling cane and manifold clean and intact?			✓	
Is the manifold blower motor working?			✓	
Are all sample lines clean and moisture-free?			✓	
Is DAS operational and indicating proper time and date?			✓	
Are site visits performed at (minimum) bi-weekly intervals?			✓	
Are P/Z/S checks performed at (minimum) bi-weekly intervals?			✓	
Are manual "Through-the-Probe" P/Z/S checks performed at monthly intervals?			✓	
Are multi-point calibrations performed at (minimum) semi-annual intervals?			✓	
GENERAL SITE CONDITIONS			YES	NO
Is the station interior neat and orderly?			✓	
Is the condition of trailer exterior acceptable?			✓	
Is the site temperature maintained between 20° and 30°C?			✓	
Are the site grounds well maintained?			✓	
DOCUMENTATION AND FORMS			YES	NO
Is the station logbook present?			✓	
Are the station logs up-to-date?			✓	
Are the station logs detailed and legible?			✓	
Are the calibration forms present?			✓	
Are calibration certificates for gas cylinders and calibrators posted?			✓	

AIR QUALITY SYSTEMS AUDIT CHECKLIST

(Page 2 of 2)

Network: AMEREN LABADIE	Audit Date: 10/8/15
Site: VALLEY	Auditor: KEVIN RUGGIERO

OVERALL COMMENTS	YES	NO
Overall, is the station well maintained?	✓	
Overall, is the data quality good?	✓	
Are Quality Assurance/Quality Control maintained?	✓	
Is the site and equipment in good working order?	✓	
Do site operating personnel follow safe work practices?	✓	
Are there any safety issues at the monitoring station?	✓	
Overall, is the site technician knowledgeable and following Standard Operating Procedures?	✓	
Are there any unresolved problems at the site? (describe in "Comments" below)		✓

Comments:

Site Technician: _____

Auditor: Ken Kiger

QA Review: [Signature]

ENVIROPLAN CONSULTING

CONTINUOUS GASEOUS POLLUTANT ANALYZER AUDIT FORM

PARAMETER AUDITED (Check One): ☒ X ☐ SO₂ ☐ CO ☐ TRS

Network: AMEREN LABADIE	Site: VALLEY	Audit Date: 10/8/15
Time Off-Line: 14:00 CST	Time On-Line: 15:14 CST	Shelter Temperature: 27.7° C

Site Equipment	Analyzer Mfg./Model No.: TAPI T100	S/N: 534	Cal. Date: 9/5/15
	Analyzer Calibration Factors:	Span Setting: 0.989	Zero Setting: 15.6
	Calibrator Mfg./Model No.: TAPI T700	S/N: 547	Cal. Date: 9/5/15
	Gas Cylinder Vendor and S/N: SCOTT MARRIN CC102857	Tank Pressure: 1900	PSIG
	Gas Cylinder Cert. Date: 10/14/14	Cylinder Conc. (ppm): 54.1	
Audit System	Calibrator Mfg./Model No.: TAPI T700	S/N: 112	Cal. Date: 6/3/15
	Zero Air Supply Mfg./Model No.: TAPI M701	S/N: 4662	
	Gas Cylinder Vendor and S/N: SCOTT MARRIN JA01285	Tank Pressure: 1925	PSIG
	Gas Cylinder Cert. Date: 10/14/14	Cylinder Conc. (ppm): 53.5	

Calibrator Gas Flow		Calibrator Dilution Flow		Known Audit Concentration (ppb)	System Response		Results
Calibrator Setting	SCCM	Calibrator Setting	SCCM		Analyzer Output (Volts)	DAS (ppb)	Δ%
0.0135	0.0138	4.987	5.257	140	-	132	-5.7
0.0076	0.0078	4.992	5.262	80	-	76	-5.0
0.0027	0.0030	4.991	5.268	30	-	28	-6.7
OFF	OFF	5.000	5.256	0	-	0	-
Slope = 0.944568		Intercept = -0.035477		Correlation Coefficient (r) = 0.999982			

Comments:

Site Technician: _____

Auditor: Hemphill

QA Review: Hemphill

ENVIROPLAN CONSULTING

FORM 10-1: METEOROLOGICAL SYSTEMS AUDIT CHECKLIST

(Page 1 of 2)

Network: <i>Ameren Labadie</i>	Audit Date: <i>10-9-15</i>	
Site: <i>Valley</i>	Auditor: <i>Kevin Dussiers</i>	
GENERAL SITE CONDITIONS	Yes	No
Is the station interior neat and orderly?	<input checked="" type="checkbox"/>	
Is the structural condition of the equipment shelter acceptable?	<input checked="" type="checkbox"/>	
Is the shelter temperature regulation compatible with stable and proper instrument operation?	<input checked="" type="checkbox"/>	
Are the site grounds well maintained?	<input checked="" type="checkbox"/>	
EXPOSURE OF INSTRUMENTS	Yes	No
Are all booms rigid, level and properly aligned?	<input checked="" type="checkbox"/>	
Are wind sensors plumb, and rigidly mounted at least two tower widths away from tower or one tower width above tower?	<input checked="" type="checkbox"/>	
Is the tower in good physical condition, rigid and all tower cables secure?	<input checked="" type="checkbox"/>	
Are temperature sensors housed in aspirated radiation shields?	<input checked="" type="checkbox"/>	
Are humidity and/or dew point sensors housed in aspirated radiation shields?	<input checked="" type="checkbox"/>	
Are radiation sensors clean, level and unobstructed from the sun all year?	<input checked="" type="checkbox"/>	
Are precipitation sensors properly elevated, level, located away from any drip lines and protected with a wind break?	<input checked="" type="checkbox"/>	
OPERATIONS	Yes	No
Are all sensors operational?	<input checked="" type="checkbox"/>	
Are all signal connections clean, protected and rust free?	<input checked="" type="checkbox"/>	
Are all vanes/cups/propellers intact?	<input checked="" type="checkbox"/>	
Are wind speed and wind direction bearings replaced on schedule?	<input checked="" type="checkbox"/>	
Are all wind sensor heating jackets intact and operational?	<input checked="" type="checkbox"/>	
Are all aspirators clean and aspirator fan(s) operational?	<input checked="" type="checkbox"/>	
Is the precipitation gauge clean?	<input checked="" type="checkbox"/>	
Is D.A.S. operational and indicate proper time and date?	<input checked="" type="checkbox"/>	
Are routine site checks performed at weekly intervals?	<input checked="" type="checkbox"/>	
Are calibration checks performed as scheduled?	<input checked="" type="checkbox"/>	

(Page 2 of 2)

Comments:

Auditor: Kent Ryd
ENVIROPLAN CONSULTING

FORM 10-2: PERFORMANCE TEST DATA FOR HORIZONTAL WIND SPEED MEASUREMENT SYSTEM

Performance Test is a: ☒ Audit (or) ☒ Calibration (check one; if calibration, explain reason below)

Network: <u>Ameren Labadie</u>		Test Date(s): <u>10-9-15</u>	
Site: <u>Valley</u>		Site Operator: <u>Bill Ault</u>	
Sensor Level (AGL): <u> </u>		Instrument Range: 0.0 mph to 50.0 m/s	
Sensor Height (AGL): <u>10 m</u> m		Time off line: <u>07:45 CST</u> Time on line: <u>12:51 CST</u>	
System Component	Manufacturer	Model Number	Serial Number "As Found" "As Left"
Sensor	Climatronics	100075	<u>N2289C</u> <u>N2289C</u>
Data Acquisition System	Campbell Scientific	CR-1000	<u>53016</u>

WS PERFORMANCE TEST ACCEPTABILITY LIMITS (Climatronics F-460 Cup Anemometer)

Type of Test	"As Found"	"As Left"
Sensor Starting Torque	< 0.2 gm-cm	Same as "As Found"
Overall System Error	≤ 0.2 m/s (compared to True)	Same as "As Found"

SYSTEM TEST RESULTS:

STATUS	MOTOR RPM	TARGET (m/s) (A)	DAS (m/s) (B)	ERROR (m/s) (= B-A)
AS FOUND	0	0.2	<u>0.1</u>	<u>-0.1</u>
	300	7.2	<u>7.2</u>	<u>0.0</u>
	600	14.2	<u>14.2</u>	<u>0.0</u>
	900	21.3	<u>21.4</u>	<u>0.1</u>
AS LEFT	0	0.2	<u>0.1</u>	<u>-0.1</u>
	300	7.2	<u>7.2</u>	<u>0.0</u>
	600	14.2	<u>14.2</u>	<u>0.0</u>
	900	21.3	<u>21.3</u>	<u>0.0</u>

"As Found" bearing torque check: Clockwise: <0.2 gm-cm; Counter-clockwise: <0.2 gm-cm

Sensor bearings: Last replaced: 10-9-15 Next due: 4-9-16

"As Left" bearing torque check: Clockwise: <0.2 gm-cm; Counter-clockwise: <0.2 gm-cm

Comments: Replaced bearings.

Technician:

Auditor: (if applicable)

QA Review:

ENVIROPLAN CONSULTING

FORM 10-3: PERFORMANCE TEST DATA FOR VERTICAL WIND SPEED MEASUREMENT SYSTEMS

 Performance Test is a: ☒ Audit (or) ☒ Calibration (check one; if calibration, explain reason below)

Network: <u>Ameren Labadie</u>	Test Date(s): <u>10-9-15</u>
Site: <u>Valley</u>	Site Operator: <u>Bill Ault</u>
Sensor Level (AGL):	Instrument Range: -25.0 mph to 25.0 m/s
Sensor Height (AGL): <u>10 m</u> m	Time off line: <u>07:45 EST</u> Time on line: <u>12:51 CST</u>

System Component	Manufacturer	Model Number	Serial Number "As Found" "As Left"	
Sensor	Climatronics	102236	<u>P12197</u>	<u>P12197</u>
Data Acquisition System	Campbell Scientific	CR-1000	<u>53016</u>	

**WS PERFORMANCE TEST ACCEPTABILITY LIMITS
(Climatronics Vertical Component Anemometer)**

Type of Test	"As Found"	"As Left"
1. Sensor Starting Torque	< 0.3 gm-cm	< 0.14 gm-cm
2. Overall System Error	≤ 0.2 m/s (compared to True)	Same as "As Found"

SYSTEM TEST RESULTS:

STATUS	MOTOR RPM	TARGET (m/s) (A)	"AS FOUND"		"AS LEFT"	
			DAS (m/s) (B)	ERROR (m/s) (= B-A)	DAS (m/s) (C)	ERROR (m/s) (= C-A)
CLOCKWISE	0	0.0	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
	300	1.9	<u>1.9</u>	<u>0.0</u>	<u>1.9</u>	<u>0.0</u>
	600	3.75	<u>3.80</u>	<u>0.05</u>	<u>3.79</u>	<u>0.04</u>
	900	5.6	<u>5.7</u>	<u>0.1</u>	<u>5.7</u>	<u>0.1</u>
COUNTER-CLOCKWISE	0	0.0	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
	300	-1.9	<u>-1.9</u>	<u>0.0</u>	<u>-1.9</u>	<u>0.0</u>
	600	-3.75	<u>-3.74</u>	<u>-0.01</u>	<u>-3.75</u>	<u>0.0</u>
	900	-5.6	<u>-5.6</u>	<u>KR -50.0</u>	<u>-5.6</u>	<u>0.0</u>

 "As Found" bearing torque check: Clockwise: <0.3 gm-cm; Counter-clockwise: <0.3 gm-cm

 Sensor bearings: Last replaced: 10-9-15 Next due: 4-9-16

 "As Left" bearing torque check: Clockwise: <0.3 gm-cm; Counter-clockwise: <0.3 gm-cm

 Comments: Replaced bearings.

Technician:

Auditor: (if applicable)

QA Review:

ENVIROPLAN CONSULTING

FORM 10-4: PERFORMANCE TEST DATA FOR WIND DIRECTION MEASUREMENT SYSTEMS

Performance Test is a: X Audit (or) X Calibration (check one; if calibration, explain reason below)

Network: <u>Ameren Labadie</u>	Test Date(s): <u>10-9-15</u>
Site: <u>Valley</u>	Site Operator: <u>Bill Ault</u>
Sensor Level (AGL):	Instrument Range: 0 to 360 Degrees
Sensor Height (AGL): <u>10 m</u> m	Time off line: <u>07:45 CST</u> Time on line: <u>12:51 CST</u>

System Component	Manufacturer	Model Number	Serial Number	
			"As Found"	"As Left"
Sensor	Climatronics	100076	<u>N2310C</u>	<u>N2310C</u>
Data Acquisition System	Campbell Scientific	CR-1000	<u>53016</u>	

WD PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
Sensor Starting Torque	< 6 gm-cm (CW & CCW)	< 3 gm-cm (CW & CCW)
Sensor Orientation Error	$\pm \leq 2^\circ$	$\pm \leq 1^\circ$
Total System Azimuth Error	$\pm \leq 5^\circ$	$\pm \leq 5^\circ$ (preferably $\pm \leq 3^\circ$)

SYSTEM TEST RESULTS:

TEST POINT (A)	AS FOUND			AS LEFT		
	DAS (B)	Sensor Error (B-A) = C	Total Error (= C-D)	(E) DAS	Sensor Error (A-E) = F	Total Error (= F-G)
30°	<u>29</u>	<u>-1</u>	<u>-1</u>	<u>30</u>	<u>0</u>	<u>0</u>
60°	<u>59</u>	<u>-1</u>	<u>-1</u>	<u>60</u>	<u>0</u>	<u>0</u>
90°	<u>89</u>	<u>-1</u>	<u>-1</u>	<u>92</u>	<u>2</u>	<u>2</u>
120°	<u>120</u>	<u>0</u>	<u>0</u>	<u>121</u>	<u>1</u>	<u>1</u>
150°	<u>150</u>	<u>0</u>	<u>0</u>	<u>152</u>	<u>2</u>	<u>2</u>
180°	<u>181</u>	<u>1</u>	<u>1</u>	<u>182</u>	<u>2</u>	<u>2</u>
210°	<u>210</u>	<u>0</u>	<u>0</u>	<u>211</u>	<u>1</u>	<u>1</u>
240°	<u>238</u>	<u>-2</u>	<u>-2</u>	<u>241</u>	<u>1</u>	<u>1</u>
270°	<u>270</u>	<u>0</u>	<u>0</u>	<u>271</u>	<u>1</u>	<u>1</u>
300°	<u>301</u>	<u>1</u>	<u>1</u>	<u>302</u>	<u>2</u>	<u>2</u>
330°	<u>331</u>	<u>1</u>	<u>1</u>	<u>332</u>	<u>2</u>	<u>2</u>
360°	<u>360</u>	<u>0</u>	<u>0</u>	<u>361</u>	<u>1</u>	<u>1</u>

Sensor orientation relative to true north: (D) 0 Degrees (as found); (G) 0 Degrees (as left)

"As found" bearing torque check: Clockwise < 3 gm-cm; Counter-clockwise < 3 gm-cm

Bearings last replaced: 10-9-15 Next Due: 4-9-16

"As left" bearing torque check: Clockwise < 3 gm-cm; Counter-clockwise < 3 gm-cm

Comments: Magnetic Declination of Site = -1°. Replaced bearing.

Technician: _____ Auditor: (if applicable): Ken K... ..

QA Review: [Signature]

ENVIROPLAN CONSULTING

FORM 10-5: PERFORMANCE TEST DATA FOR AIR TEMPERATURE MEASUREMENT SYSTEMS

Performance Test is a: X Audit (or) Calibration (check one; if calibration, explain reason below)

Network: <u>Ameren Labadie</u>		Test Date(s): <u>10-9-15</u>	
Site: <u>Valley</u>		Site Operator: <u>Bill Ault</u>	
Sensor Level (AGL):		Instrument Range: -30.0 to +50.0 °C	
Sensor Height (AGL): <u>10 m</u> m		Time off line: <u>07:45 CST</u> Time on line: <u>12:51 CST</u>	
System Component	Manufacturer	Model Number	Serial Number "As Found" "As Left"
Sensor	Climatronics	100093	<u>P11360</u> <u>N/C</u>
Data Acquisition System	Campbell Scientific	CR-1000	<u>53016</u>

TEMPERATURE PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
Total System Error (DAS Response -Reference Temp. = Error)	Error $\leq \pm 0.5^{\circ}\text{C}$ (each test point)	Error $\leq \pm 0.5^{\circ}\text{C}$ (each test point) (Preferably: $\leq \pm 0.2^{\circ}\text{C}$, each test point)

SPECIAL NOTES:

1. Assess system accuracy at three known temperatures (immersing the probe and reference thermometer together in stable thermal masses). Known temperatures should include an ice slurry bath, a "room temp." bath ($\sim 15^{\circ} \sim 27^{\circ}\text{C}$) and a "hot" bath (75 ~ 95% of positive portion of measurement range).
2. Ensure probe radiation shield is clean, in good physical condition and has unobstructed air flow. If shield is actively aspirated, ensure blower fan is operating properly. Note any deficiencies in "Comments" section below.

System Test Results:

TEST POINT	"AS FOUND"			"AS LEFT"		
	Reference Temp. ($^{\circ}\text{C}$) (A)	DAS ($^{\circ}\text{C}$) (B)	System Error ($^{\circ}\text{C}$) (= B - A)	Reference Temp. ($^{\circ}\text{C}$) (A)	DAS ($^{\circ}\text{C}$) (B)	System Error ($^{\circ}\text{C}$) (= B - A)
Ice Bath (0.1 - 0.2 $^{\circ}\text{C}$)	<u>0.1</u>	<u>0.2</u>	<u>0.1</u>			
"Ambient" (15 - 25 $^{\circ}\text{C}$)	<u>21.0</u>	<u>21.0</u>	<u>0.0</u>			
Hot Bath (35 - 48 $^{\circ}\text{C}$)	<u>32.9</u>	<u>33.0</u>	<u>0.1</u>			

Comments:

Technician: _____ Auditor: (if applicable): Ken Gert

QA Review: Starns

ENVIROPLAN CONSULTING

FORM 10-5: PERFORMANCE TEST DATA FOR AIR TEMPERATURE MEASUREMENT SYSTEMS

Performance Test is a: A Audit (or) Calibration (check one; if calibration, explain reason below)

Network: <u>Ameren Labadie</u>		Test Date(s): <u>10-9-15</u>	
Site: <u>Valley</u>		Site Operator: <u>Bill Ault</u>	
Sensor Level (AGL): <u>2m</u> m		Instrument Range: -30.0 to +50.0 °C	
Location: Latitude: Longitude:		Time off line: <u>07:45 CST</u> Time on line: <u>12:51 CST</u>	
System Component	Manufacturer	Model Number	Serial Number "As Found" "As Left"
Sensor	Climatronics	100093	<u>P10913</u> <u>N/C</u>
Data Acquisition System	Campbell Scientific	CR-1000	<u>53066</u>

TEMPERATURE PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
Total System Error (DAS Response -Reference Temp. = Error)	Error $\leq \pm 0.5^{\circ}\text{C}$ (each test point)	All Errors: $\leq \pm 0.5^{\circ}\text{C}$ (Preferably: $\leq \pm 0.2^{\circ}\text{C}$)

SPECIAL NOTES:

1. Assess system accuracy at three known temperatures (immersing the probe and reference thermometer together in stable thermal masses). Known temperatures should include an ice slurry bath, an "ambient" bath ($15^{\circ} \sim 27^{\circ}\text{C}$) and a "hot" bath ($30^{\circ} \sim 48^{\circ}\text{C}$).
2. Ensure probe radiation shield is clean, in good physical condition and has unobstructed air flow. If shield is actively aspirated, ensure blower fan is operating properly. Note any deficiencies in "Comments" section below.

SYSTEM PERFORMANCE TEST DATA

TEST POINT	"AS FOUND"			"AS LEFT"		
	Reference Temp. ($^{\circ}\text{C}$) (A)	DAS Temp. ($^{\circ}\text{C}$) (B)	System Error ($^{\circ}\text{C}$) (= B - A)	Reference Temp. ($^{\circ}\text{C}$) (A)	DAS Temp. ($^{\circ}\text{C}$) (B)	System Error ($^{\circ}\text{C}$) (= B - A)
Ice Bath ($0.1 - 0.2^{\circ}\text{C}$)	<u>0.1</u>	<u>0.2</u>	<u>0.1</u>			
"Ambient" ($15 - 25^{\circ}\text{C}$)	<u>21.0</u>	<u>21.0</u>	<u>0.0</u>			
Hot Bath ($30 - 48^{\circ}\text{C}$)	<u>32.1</u>	<u>32.0</u>	<u>-0.1</u>			

Comments:

Technician: _____ Auditor: (if applicable): Ken Rosco

QA Review: [Signature]

ENVIROPLAN CONSULTING

FORM 10-6: PERFORMANCE EVALUATION DATA FOR TEMPERATURE DIFFERENCE MEASUREMENT SYSTEMS

Performance Test is a: K Audit (or) _____ Calibration (check one; if calibration, explain reason below)

Network: <u>Ameren LaBadie</u>		Test Date(s): <u>10-9-15</u>	
Site: <u>Valley</u>		Site Operator: <u>Bill Antt</u>	
Upper Sensor Height (AGL): <u>10</u> m	Lower Sensor Height (AGL): <u>2</u> m	Measurement Range: Temperature Difference Values are calculated by on-site data logger (no range limit)	
Location: Latitude: _____ Longitude: _____		Time off line: <u>07:45 CST</u> Time on line: <u>12:51 CST</u>	
System Component	Manufacturer	Model Number	Serial Number "As Found" "As Left"
Upper Sensor	Climatronics	100093	<u>P11360</u> <u>N/C</u>
Lower Sensor	Climatronics	100093	<u>P10913</u> <u>N/C</u>
Data Acquisition System	Campbell Scientific	CR-1000	<u>53016</u>

TEMPERATURE DIFFERENCE PERFORMANCE ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
Δ -T System Error = Upper Probe System Error - Lower Probe System Error (Errors obtained at each of three temperature test ranges and transcribed from Form 10-5)	Error $\leq \pm 0.1^{\circ}\text{C}$	Error $\leq \pm 0.1^{\circ}\text{C}$

SPECIAL NOTES: Use this form for temperature difference measurement systems wherein air temperatures are reported at two levels on the tower and the on-site DAS calculates the temperature difference data values.

- Air temperature performance test data are obtained and recorded for two separate air temperature measurement systems operated at two different heights. Each air temperature measurement system is tested at 3 different temperature ranges (Ice slurry bath, ambient bath and hot bath). That test data is recorded on Form 10-5.
- For each air temperature measurement system, the system errors obtained for each test bath are recorded and inter-compared below. Errors between each temperature measurement system should not exceed $\pm 0.1^{\circ}\text{C}$.

TEMPERATURE DIFFERENCE SYSTEM PERFORMANCE TEST DATA

TEST POINT	"AS FOUND"			"AS LEFT"		
	Upper Probe System Error ($^{\circ}\text{C}$) A	Lower Probe System Error ($^{\circ}\text{C}$) B	Δ -T Error ($^{\circ}\text{C}$) (= A - B)	Upper Probe System Error ($^{\circ}\text{C}$) C	Lower Probe System Error ($^{\circ}\text{C}$) D	Δ -T Error ($^{\circ}\text{C}$) (= C - D)
Ice Bath (0.1 - 0.2 $^{\circ}\text{C}$)	<u>0.1</u>	<u>0.1</u>	<u>0.0</u>			
"Ambient" (15 - 25 $^{\circ}\text{C}$)	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>			
Hot Bath (40 - 48 $^{\circ}\text{C}$)	<u>0.1</u>	<u>0.1</u>	<u>0.0</u>			

Comments: _____

Technician: _____

Auditor: (if applicable): Ken Ruyter

QA Review: [Signature]

ENVIROPLAN CONSULTING

FORM 10-7: PERFORMANCE TEST DATA FOR TIPPING BUCKET-TYPE PRECIPITATION SYSTEMS

Performance Test is a: ☒ Audit (or) ☐ Calibration (check one; if calibration, explain reason below)

Network: <u>Ameren Labadie</u>	Test Date(s): <u>10-9-15</u>
Site: <u>Valley</u>	Site Operator: <u>Bill Ault</u>
Sensor Level (AGL):	Sensor Transfer Function: 8.24ml = 1 tip = 0.01" of precipitation (for 8-inch diameter bucket)
Sensor Height (AGL): <u>1.0</u> m	Time off line: <u>13:02 CST</u> Time on line: <u>13:37 CST</u>

System Component	Manufacturer	Model Number	Serial Number
Sensor	Climatronics	100097	<u>N15508</u>
Data Acquisition System	Campbell Scientific	CR-1000	

PRECIPITATION PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
Total System Error ($\Delta\%$ of the DAS-indicated Vs the Known equivalent).	Error $\leq \pm 10\%$	Error $\leq \pm 10\%$

SYSTEM PERFORMANCE TEST:

- A) 1.) Total volume of water introduced (from burette) 81.4 ml
2.) Rainfall equivalent of (A-1) 0.099 (use mfg's. transfer function for sensor)
- B) 1.) Total number of bucket tips during test 10
2.) Rainfall equivalent of (B-1) 0.10 (use mfg's. transfer function for sensor)
- C) DAS rainfall indication before test 0.00 (eng. units); after test 0.10 (eng. units)
- D) Total rainfall indicated by DAS 0.10 (Hourly data value, eng. units)
- E) Percent difference ($\Delta\%$): $\frac{D - A2}{A2} \times 100 = \underline{1.2} \%$

Comments:

Technician: _____ Auditor: (if applicable): Ken Rysen

QA Review: Hamer

ENVIROPLAN CONSULTING

FORM 10-8: PERFORMANCE DATA FORM FOR SOLAR RADIATION MEASUREMENT SYSTEMS

Performance Test is a: ☒ Audit (or) ☐ Calibration (check one; if calibration, explain reason below)

Network: <u>Amenem Labadie</u>	Test Date(s): <u>10-8-15 to 10-11-15</u>
Site: <u>Valley</u>	Site Operator: <u>Bill Ault</u>
Sensor Level (AGL):	Instrument Range: 0.0 to 1,395 W/m ²
Sensor Height (AGL): <u>1.5 m</u> m	Time off line: <u>10-8-15 (07:38 CST)</u> Time on line: <u>10-11-15 (12:13 CST)</u>

Site System Component	Manufacturer	Model Number	Serial Number	
			"As Found"	"As Left"
Sensor	Eppley	8-48	<u>37412</u>	<u>-</u>
Data Acquisition System	Campbell Scientific	CR-1000	<u>53016</u>	

Audit/CTS Equipment:

Component	Manufacturer	Model Number	Serial Number
Sensor	Eppley	8-48	17204
Data Acquisition System	Campbell Scientific	CR-1000	<u>53016</u>

SOLAR RADIATION PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
Total System (Averaged) Error (the arithmetic averaged error obtained from a full diurnal cycle (preferred) or several hours prior to and after peak solar radiation).	Average Error ≤ ± 5%	Average Error ≤ ± 5%

Summarized System Performance Test Results:

START Date & Time	END Date & Time	Audit CTS Average W/m ² (A) *	Site System Average W/m ² (B) *	Discrepancy (B-A) ÷ A * 100
<u>10-8-15 (09:00 CST)</u>	<u>10-11-15 (11:00 CST)</u>	<u>453</u>	<u>442</u>	<u>2.5</u> %

* **NOTE:** Hours during which either measurement system reports values that are <5% of full scale range (i.e., <70W/m²) are **excluded** from the total average)

Comments:

Technician: _____ Auditor: (if applicable): Ken Bessent

QA Review: [Signature]

ENVIROPLAN CONSULTING

FORM 10-9: PERFORMANCE TEST DATA FOR RELATIVE HUMIDITY (RH) MEASUREMENT SYSTEMS

Performance Test is a: ☒ Audit (or) ☐ Calibration (check one; if calibration, explain reason below)

Network: <u>Ameren Labadie</u>		Test Date(s): <u>10-9-15</u>	
Site: <u>Valley</u>		Site Operator: <u>Bill Ault</u>	
Sensor Level (AGL):		Instrument Range: 0 to 100%	
Sensor Height (AGL): <u>10m</u> m		Time off line: <u>07:45 CST</u> Time on line: <u>12:51 CST</u>	
Site System Component	Manufacturer	Model Number	Serial Number
Sensor	Climatronics	102798	<u>P10993</u>
Data Acquisition System	Campbell Scientific	CR-1000	<u>53016</u>

RELATIVE HUMIDITY PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
Total System (<u>Averaged</u>) Error (the arithmetic averaged error obtained from three or more discrete comparison checks).	Average Error $\leq \pm 7\%$	Average Error $\leq \pm 7\%$

SYSTEM PERFORMANCE TEST RESULTS

Test Time (L.S.T.)	REFERENCE PSYCHROMETER			SYSTEM READING	ERROR (%) = B - A
	Dry Bulb (°C)	Wet Bulb (°C)	Reference RH (%) (A)	DAS RH (%) (B)	
<u>10:45</u>	<u>17.6</u>	<u>13.9</u>	<u>66.5</u>	<u>66.8</u>	<u>0.3</u>
<u>11:30</u>	<u>23.5/18.1</u>	<u>14.3</u>	<u>66.1</u>	<u>62.6</u>	<u>-3.5</u>
<u>12:26</u>	<u>19.0</u>	<u>14.5</u>	<u>61.3</u>	<u>60.6</u>	<u>0.7</u>
Average System Error = <u>-0.8</u> %					

Comments:

Technician: _____

Auditor: (if applicable): _____

QA Review: _____

ENVIROPLAN CONSULTING

FORM 10-10: PERFORMANCE TEST DATA FOR BAROMETRIC PRESSURE MEASUREMENT SYSTEM

Performance Test is a: ☒ Audit (or) ☐ Calibration (check one; if calibration, explain reason below)

Network: <u>Ameren Labadie</u>	Test Date(s): <u>10-9-15</u>
Site: <u>Valley</u>	Site Operator: <u>Bill Ault</u>
Sensor Level (AGL):	Instrument Range: 800 – 1,100 mb
Sensor Height (AGL): <u>2m</u> m	Time off line: <u>N/A</u> Time on line: <u>N/A</u>

Site System Component	Manufacturer	Model Number	Serial Number
Sensor	Climatronics	102663	<u>N15783</u>
Data Acquisition System	Campbell Scientific	CR-1000	<u>53016</u>

Audit/CTS Equipment:

Component	Manufacturer	Model Number	Serial Number
Sensor	AIR	HB-1L	<u>9A4419</u>

BAROMETRIC PRESSURE PERFORMANCE TEST ACCEPTABILITY LIMITS

Type of Test	"As Found"	"As Left"
Total System (<u>Averaged</u>) Error (the arithmetic averaged error obtained from three or more discrete comparison checks).	Average Error $\leq \pm 3$ mb	Average Error $\leq \pm 3$ mb

SYSTEM PERFORMANCE TEST RESULTS

Test Time (L.S.T.)	Reference Barometric Pressure (mb)	Observed DAS (mb)	Error (mb)
<u>11:46</u>	<u>1005.5</u>	<u>1006.0</u>	<u>0.5</u>
<u>12:02</u>	<u>1005.4</u>	<u>1005.0</u>	<u>-0.4</u>
<u>12:10</u>	<u>1005.2</u>	<u>1006.0</u>	<u>0.8</u>
Average System Response Error =			<u>0.3</u> mb

Comments:

Technician: _____ Auditor: (if applicable): Ken Lyss

QA Review: [Signature]

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